# REVIEW OF PROPOSED AMENDMENT TO WATER QUALITY CONTROL PLAN FOR THE SACRAMENTO AND SAN JOAQUIN RIVER BASINS FOR THE CONTROL OF MERCURY IN CACHE CREEK, BEAR CREEK, SULPHUR CREEK AND HARLEY GULCH

Fiona M. Doyle, Donald H. McLaughlin Professor of Mineral Engineering
University of California, Berkeley
Department of Materials Science and Engineering
210 Hearst Mining Building #1760
Berkeley, CA 94720-1760
Tel: (510) 642 3803
Fax: (510) 643 5792

Overall, I am pleased to support the principles of the California Regional Water Quality Control Board, Central Valley Region's proposed amendment to the Water Quality Control Plan for the Sacramento and San Joaquin River Basins for the Control of Mercury in Cache Creek, Bear Creek, Sulphur Creek and Harley Gulch. There is a sound rationale in proposing water quality objectives that are based directly on the concentration of methylmercury in fish. I support the identification of Implementation Alternative 2 as the most cost-effective approach for achieving the water quality objectives in a realistic time frame. As discussed below (in the format that I was asked to follow), I do have reservations about the apparently arbitrary assignment of allocations to mines in the different watersheds, and about the wisdom of one of the remediation strategies suggested in this amendment.

**Determination of "whether the scientific portion of the proposed rule is based upon sound scientific knowledge, methods and practices" for the following issues:**

**1. The derivation of a linkage between methylmercury in water and fish.**

Although this is not my area of technical specialization, the appendices to the proposed amendment make a convincing case for a direct relationship between the concentrations of methylmercury in water and fish. Accordingly, it follows that reducing methylmercury in water should achieve the desired reduction of methylmercury concentrations in fish.

**2. Methods of analysis of total mercury loads and conclusions drawn from the analysis.**

Overall, the adopted methodologies appear sound. However, in assessing water budgets for Harley Gulch, estimates for the contributions of the west and east branches are made on the basis of area. It is possible that the drainage from the two mines in the western watershed includes groundwater (insufficient information is provided on the topography, ground water level, and the mines themselves to confirm or disprove this hypothesis). If so, the flow from the west branch would be higher than estimated, with a correspondingly higher overall load of mercury.

In addition, I was astounded by the huge amount of mercury in Cache Creek that was not attributed to any specific source. Although this is acknowledged, it does suggest that the uncertainties in the mercury budget may be significantly greater than are acknowledged. In addition, this inability to identify the source of such a large proportion of the mercury severely undermines the rationale for some of the more drastic measures that are proposed.

**3. Sediment goals for Sulphur Creek, established on concentrations of mercury in natural "background" soil and soil in mineralized zones.**

Overall, the sediment goals appear to be sound, although it would have been good to have seen some scientific discussion for the numeric targets that have been proposed.

**4. Effectiveness of proposed implementation actions in achieving the desired mercury reductions, as follows:**

**a. Reducing inorganic mercury loads**

First, it is impossible to assess whether or not the proposed implementation actions will reduce the inorganic mercury loads as projected. According to Table 3.6 of the Cache Creek TMDL, on average 349 kg/year of the 400 kg/year of inorganic mercury in Cache Creek at Rumsey comes from unknown sources. There is no evidence that the proposed reduced allocations will achieve anything like the required reduction in total mercury at the Sacramento-San Joaquin delta.

Second, I do not grasp the rationale for assigning a blanket 5% allocation for all mines, with little documentation of the conditions at, and characteristics of, each mine. From a scientific perspective, it would appear more sensible to identify those sources where the largest reduction in mercury load could be achieved most readily.

Third (P40), it is not necessarily valid to assume that a 95% reduction in mercury releases from mines can be achieved, just because this was done for copper and zinc mines in the Central Valley. The mechanism for metal mobilization and release is different.

Fourth, I am uncomfortable with the suggestion at a couple of places that streambed contamination might be addressed by allowing sediment with low concentrations of mercury to replace or bury contaminated material in the streambed. This arrangement is intrinsically unstable, and would appear to be guaranteed to release high levels of mercury during rare, but exceedingly heavy storms when unusual amounts of streambed erosion occur.

**b. Reducing methylmercury loads, and**

Although I am not an expert on wetlands, I was not convinced of the feasibility of regulating that new water impoundments or wetlands produce no net increases in methylmercury loads. There was no compelling evidence that this can be done. Accordingly, I believe that there should be serious consideration of the relative benefits of wetlands and the damage that they can cause when fed by water with high levels of mercury.

**c. Reducing fish tissue concentrations of methylmercury?**

Here, there does, indeed, appear to be a sound scientific rationale for the proposed amendment.

### 5. Estimates of time that must pass until mercury levels in sediment discharged from the Cache Creek canyon reach pre-mining conditions

On the basis of recent data, the Regional Board staff estimate of 300-500 years before sediment concentrations approach pre-mining conditions appears reasonable. However, although this is not my area of expertise, it would appear that this estimate is highly sensitive to climatic changes. It appears that most sediment movement and erosion occurs during major storms. Changes to the storm patterns could radically change the overall patterns of erosion.

### 6. Overarching questions

(a) I am concerned by the possibility that the proposed arbitrary assignment of 5% loads from mines may cause unnecessary expense, with negligible impact on water quality. There are huge differences in conditions at inactive mines in terms of drainage, topography, waste management practices, etc. It may well be the case that at some of the mines, with little waste rock in contact with runoff, a 95% reduction in mercury release would take releases to below those that would occur for undisturbed property in mineralized zones. In contrast, for others, it might be easy to achieve a 99% reduction. If one compares the Elgin Mine, responsible for (relatively) high discharges of mercury, with the Wide-Awake Mine, which discharges miniscule amounts, it would appear that a 95% reduction in discharge from the former is highly desirable, while a 95% reduction from the latter would have no impact whatsoever on water quality. Yet the cost estimates for these two properties show that the Elgin mine owners would incur significantly lower costs than Wide-Awake Mine owners. At the end of the day, when the Elgin Mine Owners would presumably be patted on the back for their efforts, they would appear to be discharging more mercury than the Wide-Awake Mine is *now* discharging. There seems no justification for such an arbitrary approach.

(b) Taken as a whole, considering merely the water quality goals, without the details of how to achieve them, the proposed amendment seems sound.

## Specific Comments on Appendices

### Cache Creek, Bear Creek, and Harley Gulch TMDL for Mercury (Staff Report - September 2004)

Section 2.3.3. This is most confusing to read. First, this section starts on the second page 10 (appearing directly after P21). Second, it refers to an equation 3-1, and I can find no numbered equation. Third, it refers to Tables 3.1, 3.2 and 3.4, which appear in the next chapter, and have nothing to do with the subject of this section.

Section 3. Pagination problems arise again, with a jump from 25 to 34.

Section 6, pp. 90-91. Assigning load allocations of five percent of existing inputs of total mercury from mines draining into Bear Creek and Harley Gulch seems a somewhat questionable strategy, given that it is acknowledged that little is known about the mines, and that the effect on the total loading of Upper Cache Creek would be miniscule. It will be exceedingly costly to achieve such a drastic percentage reduction in mercury output from the mines. Would it not be far more cost effective to identify the "unidentified" source of mercury, and achieve a relatively small percentage reduction in this? At the very least, I would suggest formally providing flexibility to implement those strategies that can accomplish the overall water quality goals in as cost effective a manner as possible.

P91: I don't follow the sentence, "Another component of the implementation plan might include a program to reduce the mercury related risk to humans consuming mercury contaminated by public outreach and education." Outreach and education shouldn't contaminate mercury.

P96: "Alternative to erosion control or removal within the lower basin, methods to facilitate burial of more contaminated sediment under sediment that is less contaminated or contains regional background levels of mercury." My concern with this strategy lies in the potential for the less contaminated layer to be washed out during flood events, once more exposing sediement with high concentrations of mercury.

### Sulphur Creek TMDL for Mercury (Draft Staff Report - August 2004)

Executive Summary, Piii: "Inactive mine sites themselves are assigned a specific allocation of no more than 5% of existing mine-related loads entering the creek from each site." From Table ES.1, it appears that these mines are assigned an allocation of no *less* than *10%.* Although this ambiguity is clarified in section 5.2, it is extremely unclear in the executive summary.

Section 2, pp. 21 and 25. It isn't clear which line is which on Figures 2.4, 2.5 or 2.6.